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(71) Applicant  
Brian Purser  
c/o The Dudley Shearing Machine Manufacturing Co.  
Ltd, Nevada Lane, Hot Lane Industrial Estate, Burslem,  
Stoke-on-Trent, ST6 2BY, United Kingdom

(72) Inventor  
Brian Purser

(74) Agent and/or Address for Service  
Swindell & Pearson  
48 Friar Gate, Derby, DE1 1GY, United Kingdom

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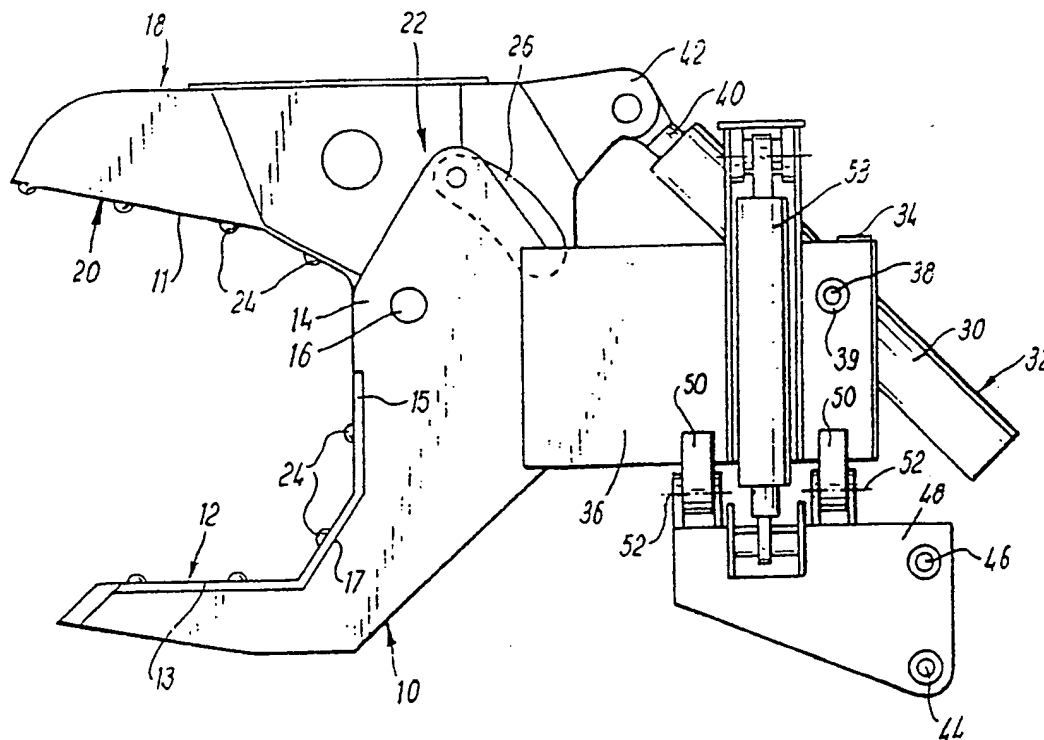
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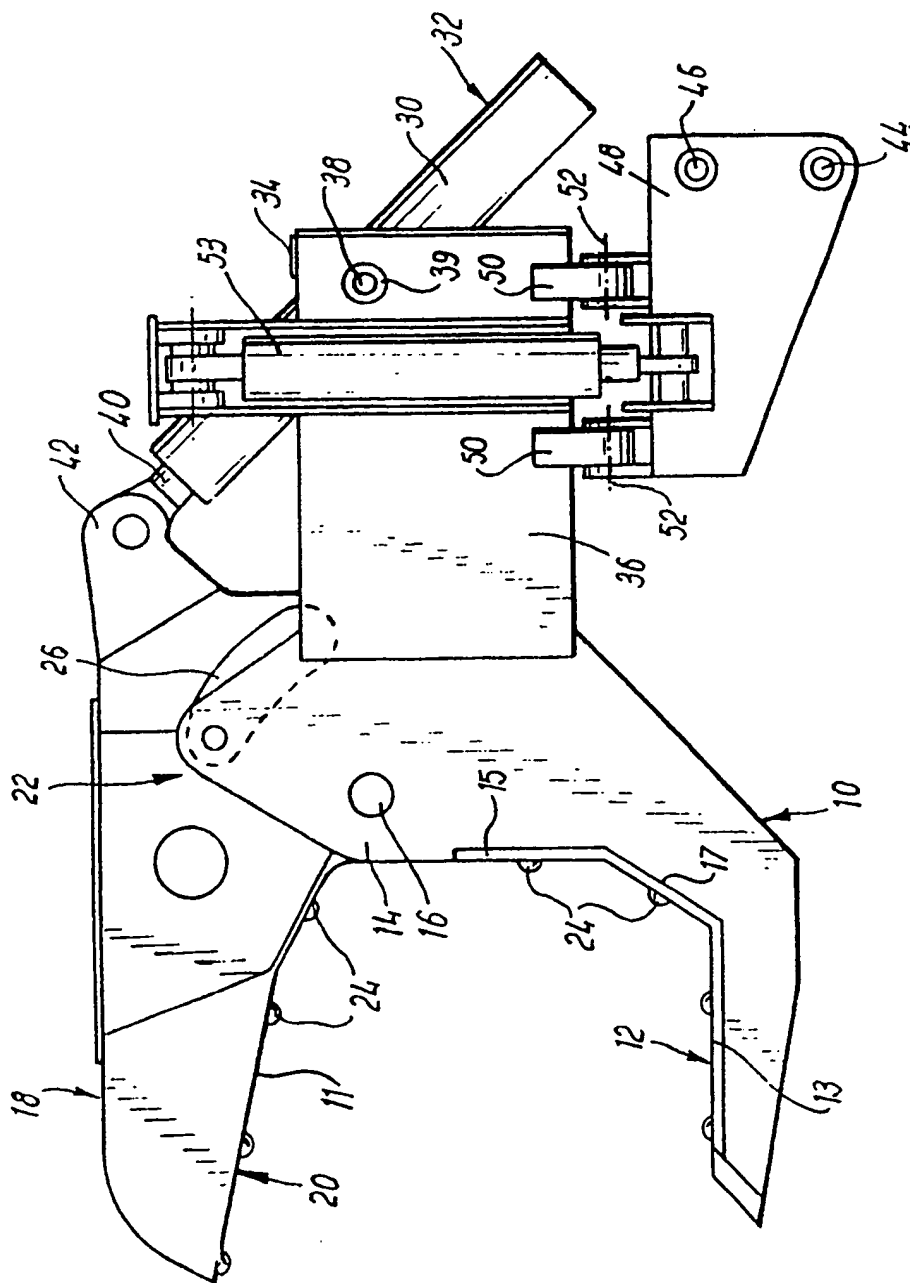
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(54) Jaw crusher

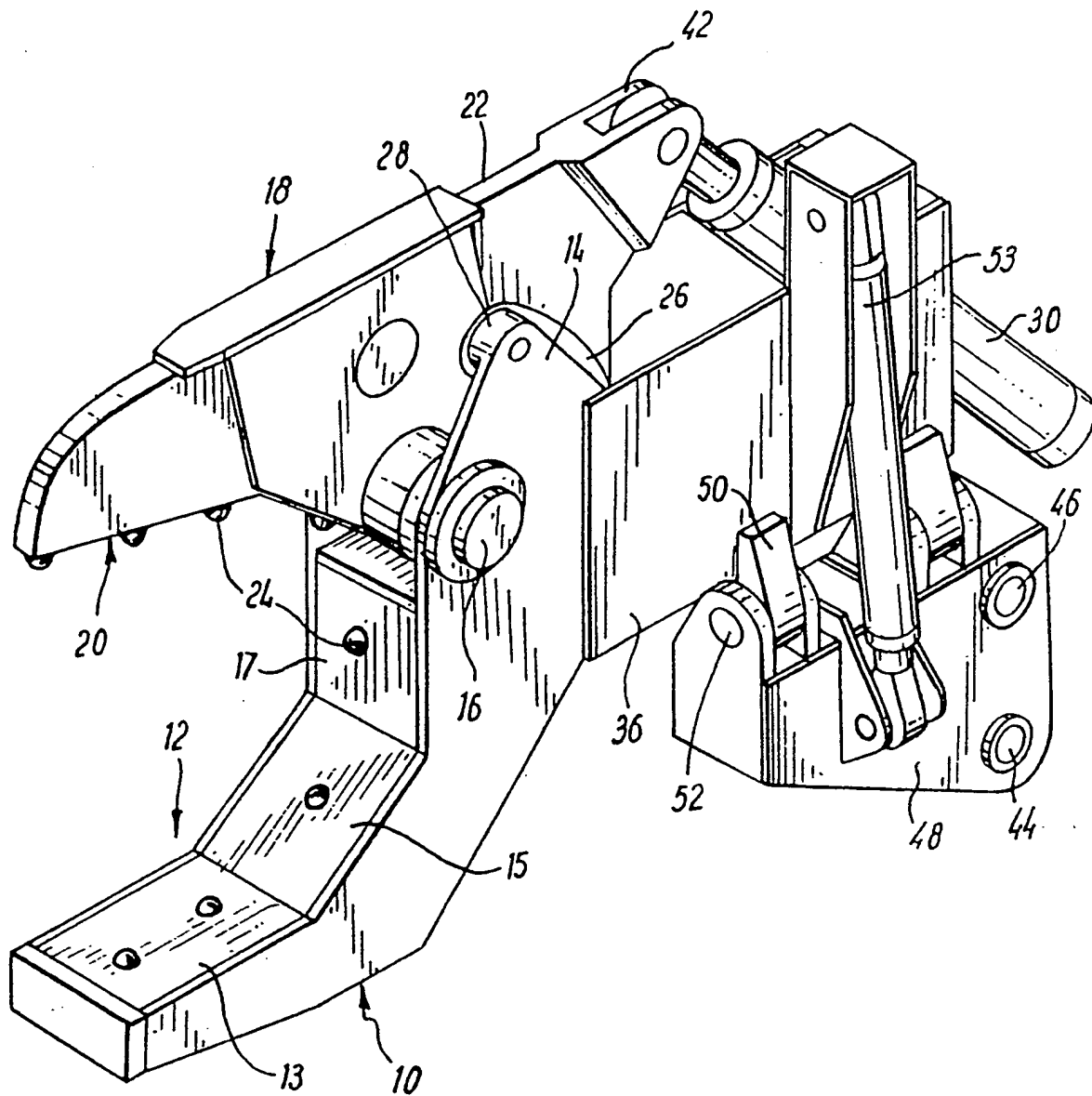
(57) Crushing apparatus provided with fixing means so that it can be replaceably mounted by means of member 48 instead of a bucket on the end of an arm of an excavator, the apparatus comprising first and second members 10, 18 with respective co-operating jaw portions 12, 20. The first member 10 mounts one end of a ram 32 attachable to the arm of the excavator and is pivotally mounted to the second member 18.



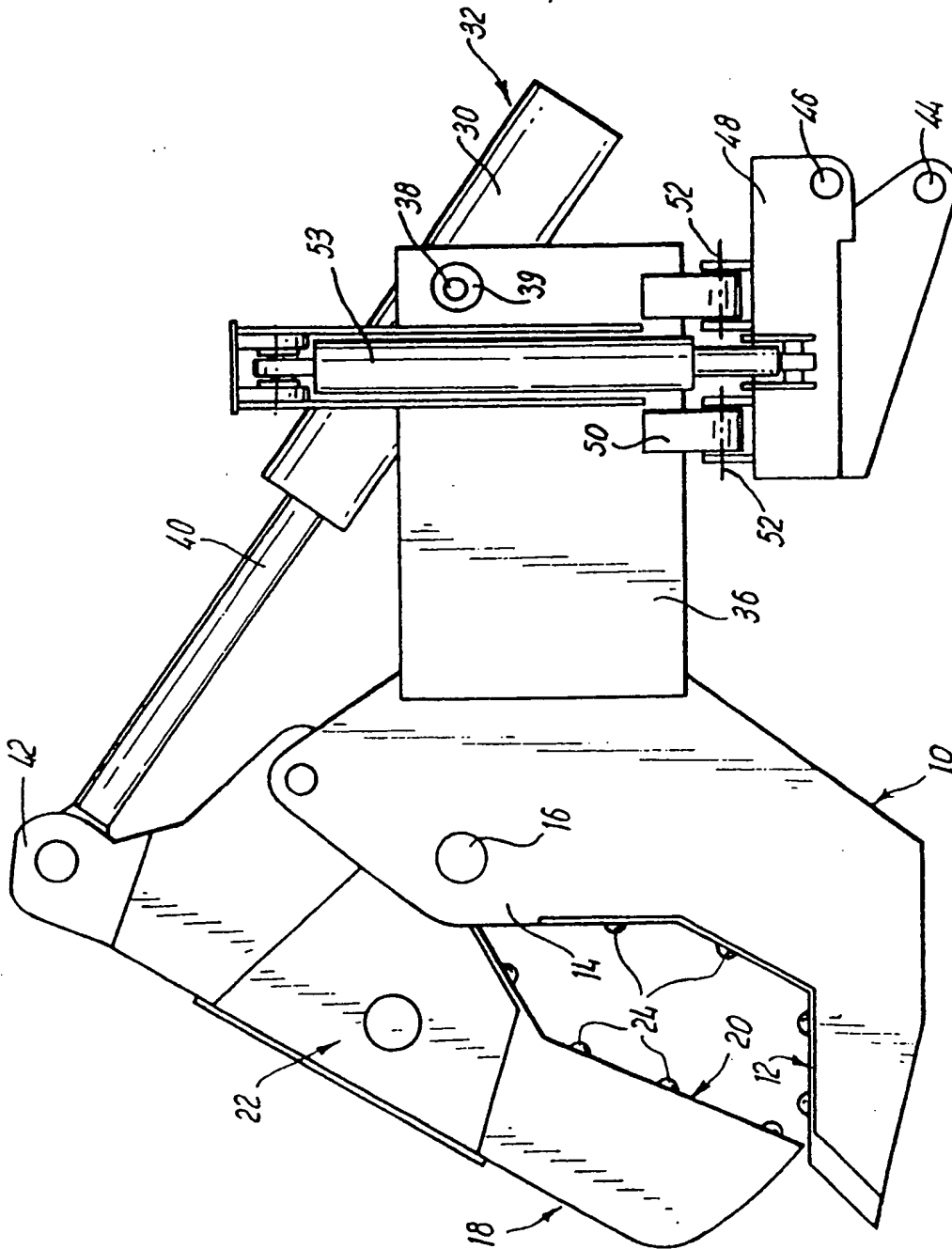
**Fig. 1**



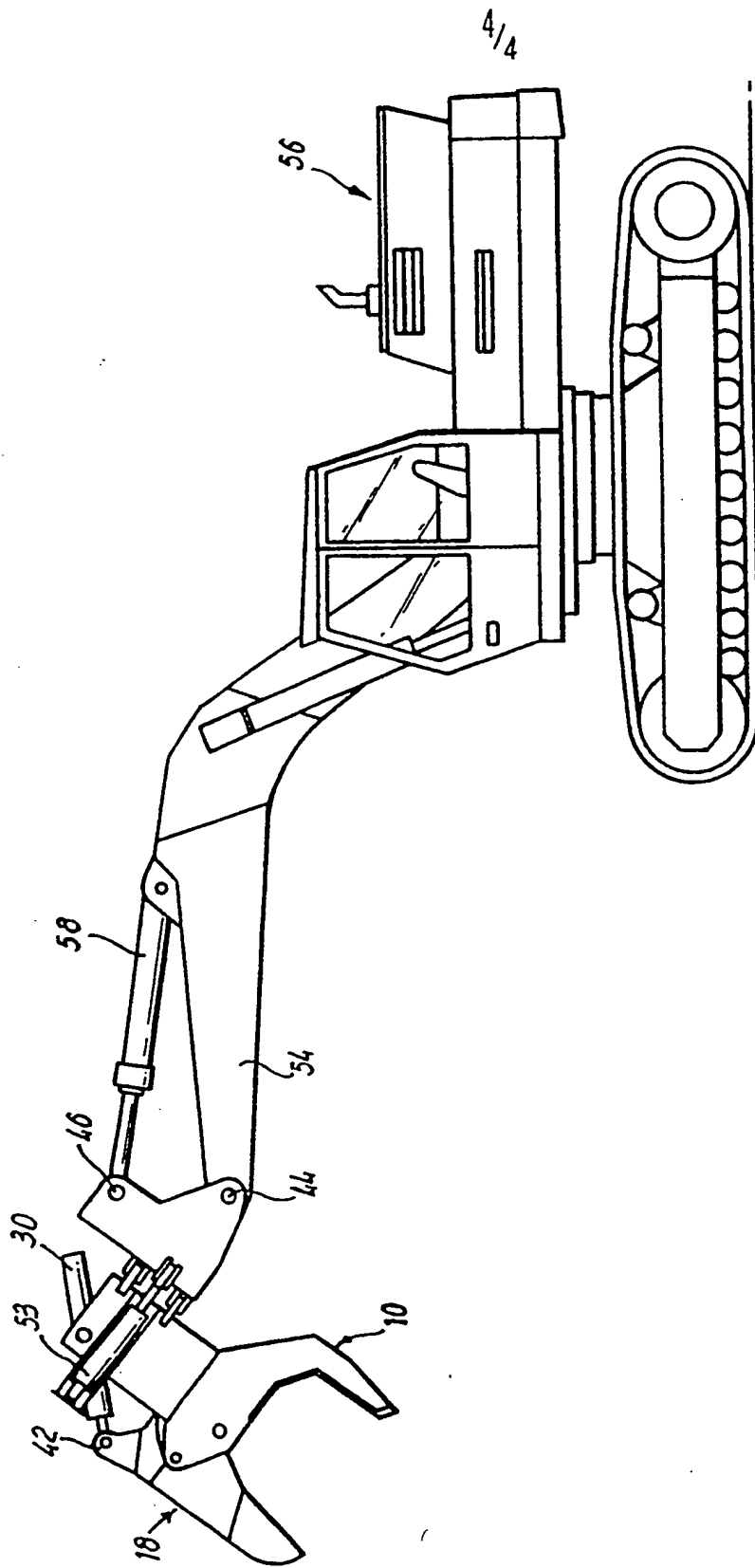
**Fig. 1**



**Fig. 2**



**Fig. 3**



**Fig. 4**

Crushing Apparatus

The invention relates to apparatus for crushing or cracking tough materials, such as all types of rock, concrete, slag and cast iron, the apparatus being mounted in use on an hydraulically-powered arm of an excavating vehicle. The term "excavating vehicle" as used herein means a vehicle having wheels or which is track-laying having an arm of one or more articulated portions, said arm being powered wholly or partially by hydraulic power and usually having mounted at an extremity of the arm a bucket for earth excavation or some other tool, for example a pneumatic or hydraulic percussion device, or means for manipulating objects such as telegraph poles, posts and the like.

Apparatus of the present invention is particularly suited for secondary breaking in a quarry i.e. after blasting but before static crushing. This is often required, or at least preferable, to permit transportation of the material. Conventionally such breaking has been accomplished using a drop ball or hydraulic hammer which presents various disadvantages and does not provide for uniform crushing of material.

The present invention seeks to provide crushing apparatus for attachment to existing vehicles, which apparatus is powerful enough to crush substantial

volumes of tough material. The invention also seeks to provide a vehicle having such apparatus fitted thereto.

The invention provides therefore crushing apparatus adapted for attachment to an arm of an excavating vehicle, the apparatus comprising a first member having a jaw on an end thereof and, remote from said jaw, fixing means by which the first member may be mounted on the vehicle arm, a second member movably mounted on said first member and having a jaw co-operable with the jaw of said first member to crush material located therebetween, and a piston and cylinder assembly mounted on one of said first and second members and connected to the other of said first and second members and operable to cause relative movement between said jaws.

The piston and cylinder assembly provided on the apparatus is preferably hydraulically driven and may be driven by the hydraulic compressor of the vehicle to which it is, in use, attached.

Preferably the second member is pivotally mounted on the first member.

Desirably the first member comprises a pair of spaced apart limbs between which the second member is

mounted. Corresponding bearing surfaces are preferably provided on the inner faces of said limbs and on the second member to prevent relative sideways or twisting movement between the first and second members

Preferably at least one of the jaws is provided with means for engaging with material to be crushed. The engaging means may comprise a plurality of projections which are desirably spikes.

Preferably the cylinder of the piston and cylinder assembly is mounted for limited pivotal movement on the first member at a point between the ends of said first member and the piston is pivotally connected at its end to the second member.

The fixing means desirably comprises a pair of pivotal mountings, one of said mountings being co-operable with the mounting provided on the vehicle arm for use normally with an excavating bucket, the second of said mountings being co-operable with the mounting provided on the piston or cylinder of an excavating-bucket-tilting ram provided on said vehicle arm. A plurality of fixing means may be provided to allow the apparatus to be transferred from one vehicle to another different vehicle having different fixings.



Further according to the present invention there is provided apparatus, wherein the first jaw has a first face and a second face substantially perpendicular thereto.

A further aspect of the present invention provides a vehicle, wherein the faces of the first jaw are wider than the face of the second jaw.

The present invention also provides an excavating vehicle, as hereinbefore defined, fitted with apparatus according to any of the preceding seven paragraphs.

Embodiments of the invention will now be described by way of example only with reference to the accompanying drawings in which:

Fig. 1 is a side view of a crushing apparatus with its jaws in the fully open position;

Fig. 2 is a perspective view of the apparatus of Fig. 1;

Fig. 3 is a view similar to Fig. 1 with the jaws in a closed position; and

Fig. 4 is a diagrammatic side view on a reduced

scale of an excavating vehicle fitted with a crushing apparatus.

The apparatus shown in the drawings comprises a first member 10 comprising a jaw portion 12 at one end from which extends two spaced parallel mounting members 14. A pivot 16 is provided between the members 14 and on this pivot is mounted a second member 18. The member 18 has a jaw portion 20 at one end which connects with a mounting portion 22 rotatable about the pivot 16. Both of the jaw portions 12, 20 may be provided with a plurality of inwardly directed protrusions 24. A kidney shaped plate 26 is fixed to each side of the mounting portion 22 and contactingly engages with a projection 28 on the inside of each of the mounting limbs 14. The engagement of the projections 26, 28 for all relative positions of the members 10, 18 restricts relative sideways or twisting movement therebetween.

A cylinder 30 of a relatively short stroke hydraulic ram 32 is mounted, by means of a trunnion (not shown) fixed to the cylinder between its ends, for pivotal movement about an axis 38 on bearings 39 provided in a cradle 36 welded on either side of the mounting members 14. An end region of a piston 40 of the ram 32 is pivotally connected to a yoke 42 fixed to the mounting

portion 22 of the second member 18. By adopting a short stroke cylinder mounted on the first member 12 at a point between the ends thereof the overall length of the apparatus is kept to a minimum and a fast operating cycle is achieved. The length of the piston 40 and the distance between the yoke 42 and the pivot 16 are carefully selected so that as the jaws arrive at a normal crushing position the piston is substantially tangential to the arc defined by the yoke 42 as the member 18 pivots about the axis 16. This means that the maximum force is transmitted to the jaws at the time of crushing.

The jaw portions 12 and 20 of the first and second members are designed with a view to increasing the crushing efficiency. As can be seen from the drawings the jaw portion 20 has a relatively planar face 11 which, if extended would substantially pass through the pivot axis 16.

The jaw 12 comprises two faces 13, 15 of substantially equal length which are substantially mutually perpendicular, connected by an intermediate face 17. These faces are wider than the face 11.

When the members are in the fully open position, as

shown in Fig. 1, the faces 11 and 13 are almost parallel to each other but spaced apart by a considerable distance allowing large objects to be crushed to be taken into the jaws. The face 15 of the first jaw, in this open position is substantially parallel to the jaw opening plane defined between the ends of the members 10,18 remote from the pivot 16. In this fully open position the faces 11,13 are substantially perpendicular to the opening plane.

When the ram 30 is actuated to pivot member 18 relative to member 10 to crush objects in the jaw the movement and jaw configuration causes the objects to be forced towards the pivot 16 into the apparatus. In the closed position, shown in Fig. 3, there still remains space between the face 11 and the faces 13,15 and 17. It is important to note that the apparatus reduces the size of objects therein by crushing rather than by shearing and that, with the exception of a relatively small amount at the pivot 16, the face 11 does not pass through or beyond the face 15 (or the faces 13 and 17).

An arrangement is provided for pivotally connecting the apparatus to the arm 54 of an excavating vehicle 56 (Fig. 4) about a pivot 44 at the end of the arm 54 normally provided for the excavating bucket of the vehicle. A further pivotal fixing 46 is provided between

the arrangement and the piston of the arm's bucket tilting ram 58. The apparatus is mounted for pivoting about an axis transverse to the pivot axis 14 of the first and second members 10,18 and to the pivot axis 44. Pivot pins 52 carried by the arrangement 48 rotably support mounting arms 50 fixed to the base of the cradle 36. A further ram 53 is connected between the cradle 36 and the arrangement 48 to cause pivotal movement of the cradle and the first and second members it carries about the pivot pins 52 when desired. This means that the operation of the jaws is not restricted to movement in a substantially vertical plane. The jaws can operate at any angle.

Various modifications may be made within the scope of the invention. For example the jaw portions 12, 20 may be differently shaped and may have a different arrangement of protrusions 24. The apparatus shown in fig. 4 has no spikes. The plates 26 could be differently shaped or a different method of preventing sideways or twisting movement could be used.

It should be realised that by providing the apparatus with its own jaw actuating ram and mounting this ram on one of the jaws, rather than by utilising, say, the bucket operating ram of the excavator which is mounted on the excavator arm, a relatively compact, lightweight and

consequently inexpensive crushing apparatus in which all the crushing forces are resisted by the components of the apparatus and are not transmitted to the arm of the excavator is provided.

CLAIMS

1. Crushing apparatus adapted for attachment to an arm of an excavating vehicle, said apparatus comprising:

a first member having a jaw on an end thereof and remote from said jaw, fixing means by which the first member may be mounted on the vehicle arm,

a second member movably mounted on said first member and having a jaw co-operable with the jaw of said first member to crush material located therebetween, and

a piston and cylinder assembly mounted on one of said first and second members and connected to the other of said first and second members and operable to cause relative movement between said jaws.

2. Apparatus according to claim 1, wherein hydraulic drive means are provided for said piston and cylinder assembly.

3. Apparatus according to claim 2, wherein said piston and cylinder assembly is driven by the hydraulic compressor of the vehicle to which it is, in use, attached.

4. Apparatus according to any one of claims 1 to 3, wherein said second member is pivotally mounted on said first member.

5. Apparatus according to any one of claims 1 to 4, wherein said first member comprises a pair of spaced apart limbs between which said second member is mounted.
6. Apparatus according to claim 5, wherein corresponding bearing surfaces are provided on the inner faces of said limbs and on said second member to prevent relative sideways or twisting movement between said first and second members.
7. Apparatus according to any one of the preceding claims, wherein engaging means is provided on at least one of said jaws for engaging with material to be crushed.
8. Apparatus according to claim 7, wherein said engaging means comprises a plurality of projections.
9. Apparatus according to claim 8, wherein said engaging means are in the form of spikes.
10. Apparatus according to any one of the preceding claims, wherein the cylinder of said piston and cylinder assembly is mounted for limited pivotal movement on said first member at a point between the ends of said first member and the piston is pivotally connected at its end to said second member.



11. Apparatus according to any of the preceding claims, wherein said fixing means comprises a pair of pivotal mountings, one of said mountings being co-operable with the mounting provided on the vehicle arm for use normally with an excavating bucket, the second of said mountings being co-operable with the mounting provided on the piston or cylinder of an excavating-bucket-tilting ram provided on the vehicle arm.

12. Apparatus according to any of the preceding claims, wherein a plurality of fixing means are provided to allow said apparatus to be transferred from one vehicle to another different vehicle having different fixings.

13. Apparatus according to any one of the preceding claims, wherein the first jaw has a first face and a second face substantially perpendicular thereto.

14. Apparatus as claimed in claim 13, wherein a third face extends between the first and second faces.

15. Apparatus as claimed in claim 13 or 14, wherein said first and second faces are of substantially equal length.

16. Apparatus as claimed in any one of claims 13 to 15, wherein the faces of the first jaw are wider than the face of the second jaw.

17. An excavating vehicle, as hereinbefore defined, fitted with apparatus comprising:

a first member having a jaw on an end thereof and also fixing means remote from said jaw by which said first member may be mounted on the vehicle arm;

a second member movably mounted on said first member and having a jaw co-operable with the jaw of said first member to crush material located therebetween;

a piston and cylinder assembly mounted on one of said first and second members and connected to the other of said first and second members and operable to cause relative movement between said jaws.

18. A vehicle according to claim 17, wherein hydraulic drive means are provided for said piston and cylinder assembly.

19. A vehicle according to claim 18, wherein said piston and cylinder assembly is driven by the hydraulic compressor of said vehicle to which it is, in use, attached.

20. A vehicle according to any one of claims 17 to 19, wherein said second member is pivotally mounted on said first member.

21. A vehicle according to any one of claims 17 to 20,

wherein said first member comprises a pair of spaced apart limbs between which said second member is mounted.

22. A vehicle according to claim 21, wherein corresponding bearing surfaces are provided on the inner faces of said limbs and on said second member to prevent relative sideways or twisting movement between said first and second members.

23. A vehicle according to any one of claims 17 to 22, wherein engaging means is provided on at least one of said jaws for engaging with material to be crushed.

24. A vehicle according to claim 23, wherein said engaging means comprises a plurality of projections.

25. A vehicle according to claim 24, wherein said engaging means are in the form of spikes.

26. A vehicle according to any one of claims 17 to 25, wherein the cylinder of said piston and cylinder assembly is mounted for limited pivotal movement on said first member at a point between the ends of said first member and the piston is pivotally connected at its end to said second member.

27. A vehicle according to any one of claims 17 to 26,

wherein said fixing means comprises a pair of pivotal mountings, one of said mountings co-operating with the mounting provided on the vehicle arm for use normally with an excavating bucket, the second of said mountings co-operating with the mounting provided on the piston or cylinder of an excavating-bucket-tilting ram provided on the vehicle arm.

28. A vehicle according to any one of claims 17 to 27, wherein the first jaw has a first face and a second face substantially perpendicular thereto.

29. A vehicle according to claim 28, wherein a third face extends between the first and second faces.

30. A vehicle according to claim 28 or 29, wherein said first and second faces are of approximately equal length.

31. A vehicle according to any one of claims 28 to 30, wherein the faces of the first jaw are wider than the face of the second jaw.

32. Crushing apparatus for crushing material adapted for attachment to an arm of an excavating vehicle said apparatus comprising:

a first member,

a first jaw on an end of the first member,

apparatus mounting means on the end of said first member remote from said jaw,

a material supporting surface on said first jaw,  
pivot means on said first member;

a second member pivotally mounted on said pivot means of said first member, a second jaw on said second member co-operable with said first jaw to crush material located therebetween,

a material engaging surface on said second jaw;

a piston and cylinder assembly mounted on said first member and connected to said second member and operable to cause relative movement of said second jaw towards and away from a jaw closed position in which only the free ends of the said jaws abut and a jaw full open position in which the free ends delimit a material entry plane, said first jaw;

said material supporting surface of the first jaw having a first portion which faces said material entry plane at all open positions of said jaws and a second portion inclined to said first portion said material engaging surface being located on the side of a line between the free end of the second jaw and the pivot means remote from the first jaw,

whereby in the jaws closed position said material engaging surface is always spaced from said material support surface except at its ends.

33. Crushing apparatus according to Claim 32, in which the material support surface of the first jaw is wider than the material engaging surface of the second jaw.

34. Crushing apparatus according to Claim 32 or 33, wherein said first and second material supporting portions of said first jaw are of substantially equal length.

35. Crushing apparatus according to any one of Claims 32 to 34, in which said first and second portions of said material supporting surface of the first jaw are spaced apart by a third portion arranged at an angle to each of said first and second portions.

36. Apparatus as claimed in any one of Claims 32 to 35, in which said first member has a cradle mounted thereon and is pivotally attached to a mounting member about an axis perpendicular to the pivot axis between the jaws, a further hydraulic piston and cylinder device being connected between said cradle and said mounting member to pivot said cradle about said mounting member.

37. Crushing apparatus, substantially as hereinbefore described with reference to the accompanying drawings.

38. A vehicle, substantially as hereinbefore described with reference to Fig. 4.

39. Any novel subject matter or combination including novel subject matter disclosed in the foregoing specification or claims and/or shown in the drawings, whether or not within the scope of or relating to the same invention as any of the preceding claims.

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